

I CLAIM:

1. An apparatus for producing a three-dimensional landmark on compact discs for subsequent use or processing of said compact discs relative to said three-dimensional landmark, said apparatus comprising:

a disc orienting station for orienting marked compact discs each having at least one reference marker marked thereon, and including means for automatically determining the angular orientation, with respect to an angular reference frame, of said at least one reference marker on said marked compact disc disposed at said disc orienting station, and means for automatically rotating said marked compact disc disposed at said disc orienting station about a central axis of said compact disc such that said at least one reference marker is disposed at a pre-determined angular orientation with respect to said angular reference frame;

a landmark forming station including means for forming said three-dimensional landmark on the marked compact disc disposed at said landmark forming station, in a location having a known angular displacement about said central axis of said compact disc with respect to said at least one reference marker;

disc transport means comprising means for transporting said compact discs in seriatim from said disc orienting station

in said predetermined angular orientation to said landmark forming station.

2. An apparatus for producing a three-dimensional landmark on compact discs for subsequent cutting of said compact discs, relative to said three-dimensional landmark, into non-standard shaped compact discs, said apparatus comprising:

a disc orienting station for orienting marked compact discs having at least one reference marker marked thereon, and including means for automatically determining the angular orientation, with respect to an angular reference frame, of said at least one reference marker on the marked compact disc disposed at said disc orienting station, and means for automatically rotating said marked compact disc disposed at said disc orienting station about a central axis of said compact disc such that said at least one reference marker is disposed at a pre-determined angular orientation with respect to said angular reference frame;

a landmark forming station including means for forming said three-dimensional landmark on the marked compact disc disposed at said landmark forming station, in a location having a known angular displacement about said central axis of said compact disc with respect to said at least one reference marker;

disc transport means comprising means for transporting said compact discs in seriatim from said disc orienting station to said landmark forming station.

3. The apparatus of claim 2, further comprising a disc unloading station whereat compact discs are unloaded from said apparatus, and said disc transport means further comprises means for transporting said compact discs in seriatim from said landmark forming station to said disc unloading station in said predetermined angular orientation.

4. The apparatus of claim 3, further comprising a disc loading station whereat marked compact discs having at least one reference marker thereon, are loaded into said apparatus, and said disc transport means further comprises means for transporting said compact discs in seriatim from said disc loading station to said disc orienting station.

5. The apparatus of claim 4, wherein said compact discs further comprise a graphical pattern thereon.

6. The apparatus of claim 5, wherein said means for forming said three-dimensional landmark comprises a drill mechanism and said three-dimensional landmark comprises a drill hole.

7. The apparatus of claim 6, wherein said first predetermined location is disposed exteriorly to said graphical pattern.

8. The apparatus of claim 7, wherein said at least one reference marker comprises first and second reference markers.

9. The apparatus of claim 8, wherein said at least one reference marker comprises first, second and third reference markers.

10. The apparatus of claim 9, wherein said reference markers are located adjacent the perimeter edge of each of said marked compact discs.

11. The apparatus of claim 10, wherein said means for automatically determining the angular orientation with respect to an angular reference frame of said at least one reference marker comprises a digital camera mounted at said disc orienting station and a computer operatively connected to said digital camera.

12. The apparatus of claim 11, wherein said means for automatically rotating the marked compact disc disposed at said disc orienting station comprises a rotatable orientation platter.

13. The apparatus of claim 12, further comprising four peripheral guides operatively mounted adjacent a rotatable orientation platter for guiding the marked compact discs onto the rotatable orientation platter.

14. The apparatus of claim 13, wherein said disc orienting station further comprises a clamping mechanism for clamping in place the marked compact disc disposed on the rotatable orientation platter.

15. The apparatus of claim 14, wherein said clamping mechanism comprises a pair of opposed finger members each pivotally mounted on a respective one of said four peripheral guides, with each finger having a clamping portion for clamping said marked compact discs in place on said rotatable orientation platter, as aforesaid.

16. The apparatus of claim 15, wherein said disc orienting station further comprises at least one proximity sensor for detecting the presence one of said compact discs on the rotatable orientation platter.

17. The apparatus of claim 16, wherein said disc transport means comprises a pick and place arm assembly.

18. The apparatus of claim 17, wherein said disc loading station, said disc orienting station, said landmark forming station, and said disc unloading station are circumferentially

arranged with respect to each other, said pick and place arm assembly is operatively mounted on said apparatus centrally between said stations, for rotary motion about a substantially vertical axis.

19. The apparatus of claim 18, wherein said pick and place arm assembly is pivotally mounted on said apparatus.

20. The apparatus of claim 19, wherein said pick and place arm assembly is pivotally mounted on said apparatus for bi-directional pivotal movement about said vertical axis.

21. The apparatus of claim 20, wherein said pick and place arm assembly comprises a first arm portion, a second arm portion, and third arm portion.

22. The apparatus of claim 21, wherein said known angular displacement about said central axis of said compact disc with respect to said at least one reference marker is zero degrees.

23. A method of producing a three-dimensional landmark on a plurality of compact discs for subsequent use or processing of said compact discs relative to said three-dimensional landmark, said method comprising the steps of:

- (A) introducing at least one reference marker onto each of said compact discs at a first

predetermined location, to thereby produce marked compact discs;

- (B) automatically determining the angular orientation with respect to an angular reference frame of said at least one reference marker on each marked compact disc;
- (C) automatically rotating each marked compact disc about a central axis of said compact disc such that said at least one reference marker is disposed at a pre-determined angular orientation with respect to an angular reference frame;
- (D) forming said three-dimensional landmark on each marked compact disc in a location having a known angular displacement about said central axis of said compact disc with respect to said at least one reference marker.

24. A method of producing a three-dimensional landmark on plurality of compact discs for subsequent cutting of said compact discs relative to said three-dimensional landmark, into non-standard shaped compact discs, said method comprising the steps of:

- (A) introducing at least one reference marker onto each of said compact discs at a first

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predetermined location, to thereby produce marked compact discs;

- (B) automatically determining the angular orientation with respect to an angular reference frame of said at least one reference marker on each marked compact disc;
- (C) automatically rotating each marked compact disc about a central axis of said compact discs such that said at least one reference marker is disposed at a pre-determined angular orientation with respect to an angular reference frame;
- (D) forming said three-dimensional landmark on each marked compact disc in a location having a known angular displacement about said central axis of said compact disc with respect to said at least one reference marker.

25. The method of claim 24, further comprising the step of introducing a graphical pattern to each marked compact disc.

26. The method of claim 25, wherein in step (A), said first predetermined location is disposed exteriorly to said graphical pattern.



27. The method of claim 26, wherein step (D) comprises drilling a drill hole through each marked compact disc in a location having a known angular displacement about said central axis of said compact disc with respect to said at least one reference marker.

28. The method of claim 27, wherein step (A) comprises printing said at least one reference marker onto each of said compact discs at a first predetermined location.

29. The method of claim 28, wherein step (A) comprises printing first and second reference markers onto each of said compact discs at first and second predetermined locations, respectively.

30. The method of claim 29, wherein step (A) comprises printing first, second and third reference markers onto each of said compact discs at first, second and third predetermined locations, respectively.

31. The method of claim 30, wherein in step (A), said first predetermined location is disposed adjacent the perimeter edge of said compact discs.

32. The method of claim 31, wherein in step (D), said known angular displacement of said drill hole with respect to said at least one reference marker is substantially zero degrees.

33. The method of claim 24, wherein step (B) and step (C) are performed at a disc orienting station and step (D) is performed at a landmark forming station, and said disc orienting station and said landmark forming station are separate and distinct one from the other, and further comprising the step of transporting said compact discs in seriatim from said disc orienting station to said landmark forming station.

34. The method of claim 33, further comprising, prior to step (B), the step of loading of a plurality of compact discs into a loading station and transporting said compact discs in seriatim from said loading station to said disc orienting station.

35. The method of claim 34, further comprising, subsequent to step (D), the step of transporting said plurality of compact discs in seriatim from said landmark forming station to a disc unloading station and thereafter unloading said compact discs from said disc unloading station.

36. The method of claim 35, wherein step (B) and step (C) are performed on one marked compact disc substantially concurrently with step (D) being performed on another marked compact disc.